



Wheelchair Automation Using Head Gesture

Mr. Vijendra P. Meshram, Ms. Pooja A. Rajurkar, Ms. Mohini M. Bhiogade,
Ms. Arundhati C. Kharabe, Mr. Dhiraj Banewar
Electronics Department, DBACER, RTMNU,
Nagpur, Maharashtra, India

Abstract—This paper introduces an automated system is to be developed to control the motor rotation of wheel chair based on head movement of physically challenged person. In order to facilitate these people for their independent movement, an accelerometer device (ADXL535) based transmitter is fitted on persons head. Depending on the head movements the transmitter will generate command signals which will be received by receiver fitted on the back of the chair. This receiver after receiving signal will drive the motor fitted to the wheel chair. The ADXL535 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs, all on a single monolithic IC. The wheel chair can be driven in any of the four directions i.e. left, right, forward, and back [1]. The automated wheelchair is based on simple electronic control system and the mechanical arrangement that is controlled by an PIC microcontroller. This automatic wheel chair can be used for people who have various other disabilities to sit on the chair and just hold the accelerometer and move it over to control the vehicle movements. It also contains obstacle detection system such as an IR sensor to detect various kind of obstacle comes in the path of chair.

Keywords: Accelerometer, Transmitter, Receiver.

I. INTRODUCTION

Wheelchair is mobility device design for shifting the patients, moving physically challenged people from one place to another with the help of attendee or by means of self propelling. The automated wheelchair runs with the electric power and operation of chair depend upon the instruction given by the patient head movement or any other mechanism.

The automated wheelchair can be developed by using the voice recognition system and also by using brain sensors. In this paper, the automated wheelchair is developed by using the head gesture based on accelerometer (ADXL535) [2].

The automated wheelchair is to be developed to control the motor rotation of wheelchair based on head movement of physically challenged person. In order to facilitate the disable people for their independent movement, an accelerometer device (ADXL535) based transmitter is fitted on persons head [1]. In the transmitter circuit, as shown in the figure1 (a), an accelerometer based on head movements generates command signals. Microcontroller gets the hex data from the accelerometer and converted into ASCII code for LCD display. LCD display the X—Y—Z values and display the values on the LCD. At the same time microcontroller gets the data and compare inside with pre-defined variables. As we change the position of hand, values are change automatically and change values are also shown on the LCD. The readings of accelerometer are used for wheel chair movements. In the receiver, as shown in the figure 1 (b), the ZIGBEE module receives signals from the transmitter. According to the signals, the driver circuit will drive the motor fitted to the wheelchair. IR sensor is used to detect the obstacles in the path of the wheelchair. Rs232 is used for interfacing between PIC controller and the ZIGBEE module. The automated wheelchair is based on simple electronic control system and the mechanical arrangement that is controlled by PIC controller.

II. PROPOSED METHODOLOGY AND DESCRIPTION

This novel method of the gesture recognition uses very small accelerometer ADXL535 placed on the head of the user as the main component in the module to detect the gesture and control the wheelchair. The benefit of using this system is that it recognizes simple gestures accurately cutting down the cost of implementation. So, a prototype intelligent wheelchair using head gesture control is developed [2]. The sensors are interfaced in front along with the main modules for safety and the PIC microcontroller is used as control unit. This gives a better technique of gesture identification which can be easily operated by the user himself. The wheelchair automation can be developed by using several mechanisms such as using voice recognition system, brain sensors, eye detection etc. In this paper, wheelchair automation is done by using head gesture based on accelerometer.

Wheelchair automation by using head gesture is to be developed to control the motor rotation of wheelchair based on head movement of physically challenged person. In order to facilitate these people for their independent movement, an accelerometer device (ADXL535) based transmitter is fitted on persons head. Based on head movements the transmitter will generate command signals which will be received by receiver fitted on the back of the chair. This receiver after receiving signal will drive the motor fitted to the wheelchair. The wheelchair can be driven in any directions. It also contains obstacle detection system to detect various kind of obstacle comes in the path of chair.

A. TRANSMITTER

In the transmitter circuit, as shown in the figure1 (a), an accelerometer based on head movements generates command signals. Microcontroller gets the hex data from the accelerometer and converted into ASCII code for LCD display. LCD display the X—Y—Z values and display the values on the LCD. At the same time microcontroller gets the data and compare inside with pre-defined variables. As we change the position of hand, values are change automatically and change values are also shown on the LCD. The readings of accelerometer are used for wheel chair movements.

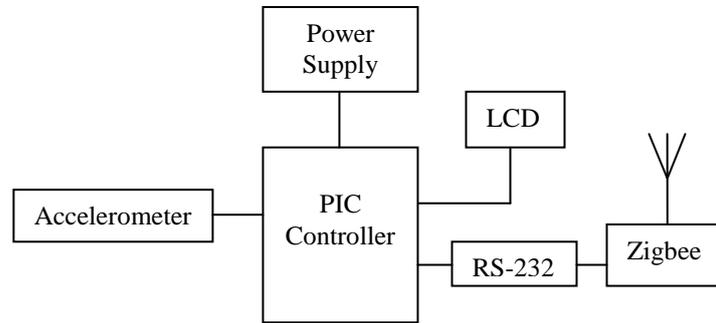


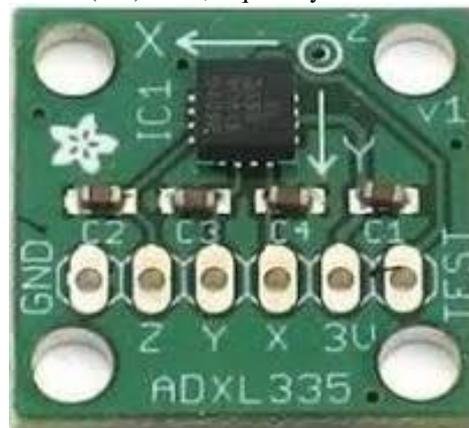
Figure 1(a) - Block Diagram of Transmitter

This system is fed with 12V dc supply. Further 5V regulated voltage is fed to PIC microcontroller, ADXL535 accelerometer, LCD and Motor Driver IC L293D. As shown in block diagram PIC microcontroller is connected to every module on circuit like LCD, Motor Driver, and Accelerometer. Whenever the circuitry operates through accelerometer mounted on the head of the user, the head tilt movement shows variation in voltage on the two axes of accelerometer. According to voltage variation in X and Y axis the direction of motor is controlled using Motor Driver IC via microcontroller. The microcontroller on receiving the signal directs the motors through the control circuit. The change of direction is achieved by changing the direction of current flow through the motor and speed control is achieved by varying the current through the motor. The Motor driver IC L293D drives the motors connected in the wheels by control action given by microcontroller unit. DC geared motors are used for controlling the two wheels of the chair independently. The LCD mounted on the system gives user friendly interaction.

ACCELEROMETER

An accelerometer is a device that measures the proper acceleration of the device. This is not necessarily the same as the coordinate acceleration (change of velocity of the device in space), but is rather the type of acceleration associated with the phenomenon of weight experienced by a test mass that

Resides in the frame of reference of the accelerometer device. For an example of where these types of acceleration differ, an accelerometer will measure a value when sitting on the ground, because masses there have weights, even though they do not change velocity. However, an accelerometer in gravitational free fall toward the centre of the Earth will measure a value of zero because, even though its speed is increasing, it is in an inertial frame of reference, in which it is weightless. By measuring the amount of static acceleration due to gravity, you can find out the angle the device is tilted at with respect to the earth. By sensing the amount of dynamic acceleration, you can analyze the way the device is moving. Accelerometer can be used to control the movement of any robotic arm or movement or control of any electrical appliances. If we install our accelerometer to our hand, then it is possible to control anything with the help of our hand. With the help of four different motions we control the direction of chair for forward, reverse left and right. An accelerometer thus measures weight per unit of (test) mass, a quantity also known as specific force, or g-force [3].



PIC18F25

PIC microcontroller is used to execute the no of operations. It is an 8 bit microcontroller having 32 KB flash ROM, 2 KB of EEPROM and 1.2 KB of RAM. It has 28 pins, out of them 25 pins are usable as digital input/output as well as all the pins have various functions like ADC, comparator, timers etc

Table 1: Specifications of PIC18F25

Parameter Name	Value
Program Memory Type	Flash
Program Memory (KB)	32
CPU Speed (MIPS)	10
RAM Bytes	1,536
Data EEPROM (bytes)	256
Digital Communication Peripherals	1-UART, 1-A/E/USART, 1-SPI, 1-I2C1-MSSP(SPI/I2C)
Capture/Compare/PWM Peripherals	2 CCP
Timers	1 x 8-bit, 3 x 16-bit
ADC	5 ch, 10-bit
Temperature Range (C)	-40 to 125
Operating Voltage Range (V)	2 to 5.5
Pin Count	28

ZIGBEE

Overview:

ZIGBEE Module is a transceiver module which provides easy to use RF communication at 2.4 GHz. It can be used to transmit and receive data at 9600 baud rates from any standard CMOS/TTL source. This module is a direct line in replacement for your serial communication it requires no extra hardware and no extra coding to It works in Half Duplex mode i.e. it provides communication in both directions, but only one direction at same time

Features:

- Supports Multiple Baud rates (9600)
- Works on ISM band (2.4 GHz)
- No complex wireless connection software or intimate knowledge of RF is required to connect our serial devices.
- Designed to be aseasy to use as cables.
- No external Antenna required.
- Plug and play device.
- Works on 5 DC supply.

Specifications:

- Input Voltage -5Volts DC
- BaudRate - 9600
- RS 232 Interface & TTL Interface
- Range – Max 30Meters - Line of Sight
- Channels - 3Ch - JP1 & JP2 - Ch1 on – On

B. RECEIVER

At the receiver side the An H-bridge is built with four switches (solid-state or mechanical). When the switches S1 and S4 (according to the first figure) are closed (and S2 and S3 are open) a positive voltage will be applied across the motor. By opening S1 and S4 switches and closing S2 and S3 switches, this voltage is reversed, allowing reverse operation of the motor. 6. The wheelchair is operated due to the Dc motor, the motor drives by the H-Bridge switching conditions. We need two H-Bridge and one H-Bridge has four transistors for motor operation as shown in the receiver circuit Fig. The four conditions on which the motor movement based are

Table: 2-Switching Binary Conditions

S1	S2	S3	S4	RESULT
1	0	0	1	Motor moves Right
0	1	1	0	Motor moves Left

0	0	0	0	Motor Stop
0	1	0	1	Motor moves Forward
1	0	1	0	Motor moves Back

The readings obtained from accelerometer for wheel Chair movements are then used. As the position of the head changes, data from the accelerometer and microcontroller also changes automatically [4]. ZIGBEE module is used for serial communication. Data from the microcontroller is connected to the input pins of encoder and transmits via output pins of the encoder. Outputs from the encoder are connected to the RF transmitter module and transmit with frequency 433 MHz. The RF receiver module sends it to the decoder which further decodes the signal and gives the signal to the opt coupler and H-Bridge circuitry which drives the motors of wheel chair based on the hand gesture and same result shown by the LCD.

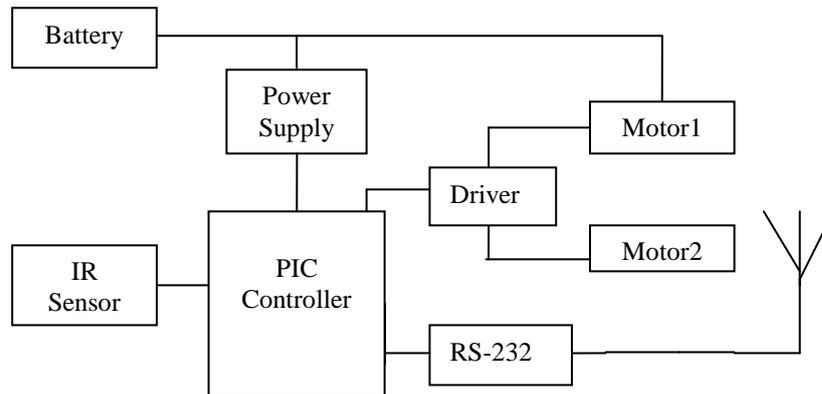


Figure 1 (b) - Block Diagram of Receiver

In the receiver, as shown in the figure 1 (b), the ZIGBEE module receives signals from the transmitter. According to the signals, the driver circuit will drive the motor fitted to the wheelchair. IR sensor is used to detect the obstacles in the path of the wheelchair. Rs232 is used for interfacing between PIC controller and the ZIGBEE module.

III. WORKING

The automated wheelchair uses the accelerometer to detect the head movements of the disable person. In the transmitter circuit , the accelerometer generates the command signal which are in the form of analogue signals corresponding to the acceleration value along the orthogonal axis(X,Y and Z). These command signals are given to the PIC18F25 at pin no.1 to 4. The supply voltage of 5V is given to the controller at pin no.20. The PIC18F25 converts the analogue signal into digital form as there is inbuilt A to D converter inside the PIC18F25. PIC18F25 is being reset at pin no.1 connecting resistor and capacitor in parallel combination. At pin no.6 and 7 of the controller, the crystal oscillator is connected for providing continuous clock pulses. The controller takes the decision depending upon the input command signals. The output of the controller is obtained at pin no.18 and 17. This output is then given to the pin no.12 and 11 of IC MAX232 which acts as a interface RS232. The IC MAX232 provides serial communication between the controller and the ZIGBEE module. The output from the pin no.13 and 14 of IC MAX232 is given to the ZIGBEE. The ZIGBEE module transmits the signal to the receiver. From the pin no.22 to 28 of the controller, the LCD is connected. LCD is used for the display of operation of the controller.

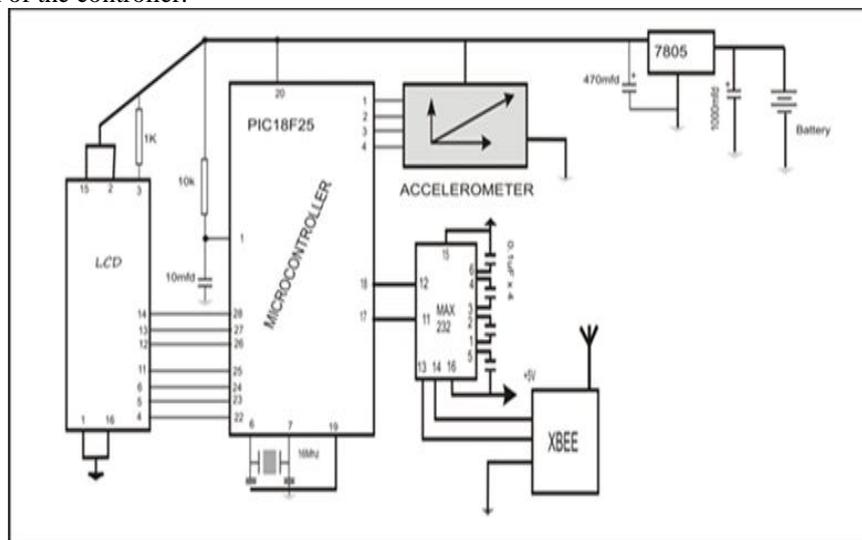


Figure 2 (a) – Circuit Diagram of Transmitter

In the receiver circuit, the ZIGBEE module receives the signal from the transmitter which is then given to the pin no.13 and 14 of IC MAX232. The IC MAX232 gives the output at pin no.11 and 12 which is connected to the pin no.17 and 18 of PIC2051. To drive the two motors, the driver circuit is used which includes the two motor driver IC's L293D. The PIC18F25 gives the output from pin no.11 to 14 which is connected to the pin no.2,7,10 and 15 of motor driver IC1 and also gives the output from pin no.16 to 22 to the motor driver IC2 at pin no.2,4,10 and 15.

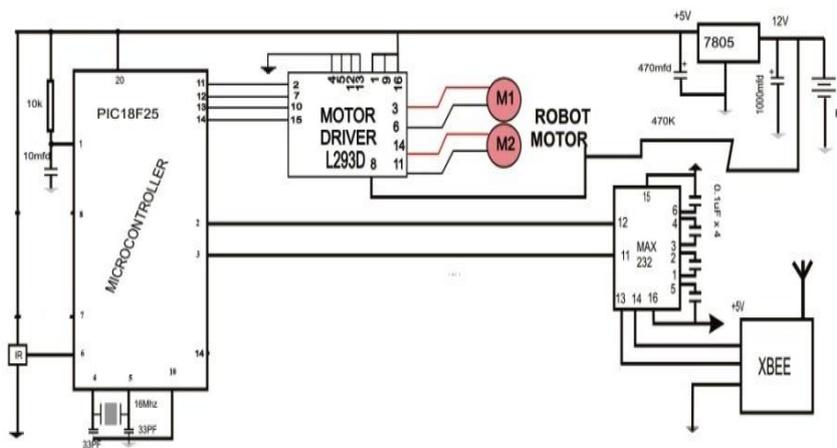


Figure 2 (b) – Circuit Diagram of Receiver

SOFTWARE

MPLAB IDE software has been used for programming purpose. In this software, KILL coding is done. The tool used is control selection. Programming is done in C language although it can be done in assembly language or in basic language. This programming is then fetched into PIC controller.

IV. RESULT

1. We obtained four combinations from acceleration sensor which we used to drive a motor in four Directions.

Direction	Motor1	Motor2
Forward	Forward	Forward
Backward	Backward	Backward
Left	Backward	Forward
Right	Forward	Backward

2. From acceleration sensor we found analogue output which got converted into digital at the output of 12 bit ADC which is followed by microcontroller. 3. The program burned into IC is running successfully to accept input from all ports and provide various combinations at output port.

V. FUTURE SCOPE

1. We can make a wheelchair which can be operated by a wireless remote. Output of sensor can be applied to wireless transmitter circuit and can received at wheelchair circuit by receiver circuitry. So, wireless operation can reduce wiring arrangements.
2. Instead of using acceleration motion (Head Movement) we can use eye retina using optical sensor to move wheelchair in different direction. Using retina movement we would be able to drive a wheelchair.
3. We can use voice command IC to interface our voice signals with microcontroller. So computer interfacing may not be needed. The voice stored in IC could be sufficient to analyze speakers voice Command.
4. Researchers are going on development of handicap wheelchair using nervous system of human.

VI. CONCLUSION

1. Automated wheelchair can be used to help handicapped people, especially those who are not able to move.
2. Our project was the complete addition of the electronic circuits, the hardware designing & software knowledge.
3. Various related work in the field of Automated Wheelchair.
4. The system was successfully implemented to move the wheelchair left, Right, Forward, Backward or Stay in same position. .

REFERENCES

- [1] Advance in Electronic and Electric Engineering. ISSN 2231-1297, Volume 3, Number 2 (2013), pp. 227-232 © Research India Publications
- [2] International Journal of Research in Electrical & Electronics Engineering Volume 2, Issue 2, April-June, 2014, pp. 10-17, © IASTER 2014 www.iaster.com, ISSN Online: 2347-5439, Print: 2348-0025
- [3] International Journal of Scientific Engineering and Technology (ISSN : 2277-1581) Volume No.3 Issue No.8, pp: 1065-1070 1 Aug 2014
- [4] International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue-6, August 2013
- [5] ArunManoharGurruma,P.S.VRamanaRaoa*, RaghuveerDontikurtia (2012), Solar Powered Wheel Chair: Mobility for Physically Challenged, International Journal of Current Engineering and Technology, Vol.2, no. 1
- [6] Khairulanuarabd Wahid (2008), Development of tilt and vibration measurement and detection system using mems accelerometer as a sensor.